# Varietal and interspecific influence on carotenoid content in *Citrus* from Mediterranean area


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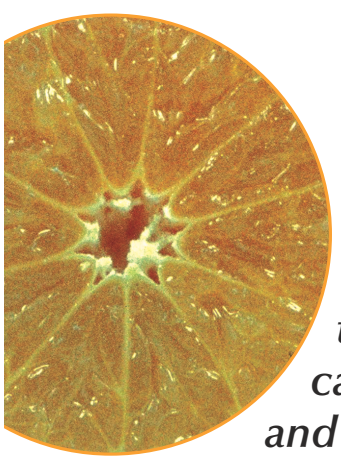
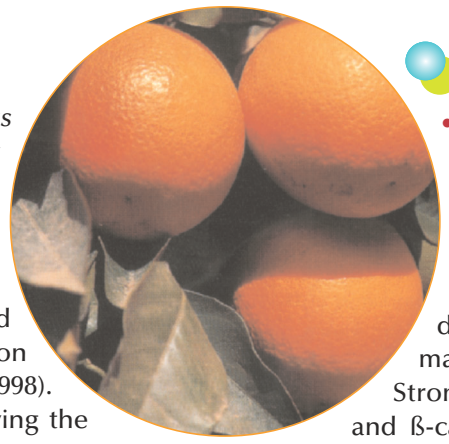



*Citrus fruits are especially rich in various antioxidant phytochemicals (vitamin C, polyphenols and carotenoids) that could contribute to their beneficial effects against degenerative diseases. In order to specify the genotypic variation of Mediterranean Citrus juices, carotenoid content was determined for eight orange varieties and mandarin species.*


## Materials and methods

Selection of orange varieties and mandarin species (*Citrus sinensis* L. Osbeck, *Citrus deliciosa* Ten, and *Citrus clementina* Hort.ex Tan) from Mediterranean area was evaluated by HPLC analysis. Representative samples (15 fruits) harvested during the 2003 season from Agronomic Research Station (Corsica Island) were collected , *Citrus* fruits were hand-squeezed, filtered and kept frozen (– 20°C) until analysed. Carotenoid extraction was carried out according to Taungbodhitham *et al.* (1998). Statistic analysis was used to develop models for classifying the juices in appropriate groups.



## Results and discussion

- Mandarin species and two cultivars of oranges, Pera and Sanguinelli displayed a high content in provitamin A carotenoid mainly due to the ß-cryptoxanthin content (1154 mg · $L^{-1}$, 960 mg · $L^{-1}$, 374 mg · $L^{-1}$, 381 mg · $L^{-1}$, respectively) (figure 1).
- Principal component analysis gave informations on the differentiation of Mediterranean orange varieties and mandarin species based on nutritional criteria (figure 2). Strong correlations were observed between ß-cryptoxanthin and ß-carotene ($r$ = 0.98) and between zeaxanthin and lutein ($r$ = 0.94). Mandarin and orange groups were distinct. Orange varieties could be divided in two groups: the first one with Pera, Sanguinelli and Valencia which displayed a higher content in ß-cryptoxanthin and zeaxanthin and the second including the four others cultivars showing lower carotenoid content.
- Diversity tree allowed to get a genetic approach in order to differentiate *Citrus* cultivars on Euclidian distances (figure 3). This representation showed that hybrid clementine was nearer of its parent mandarin than its parent orange, suggesting that ß-cryptoxanthin was a dominant genetic factor as previously supposed by Goodner *et al.* (2001).

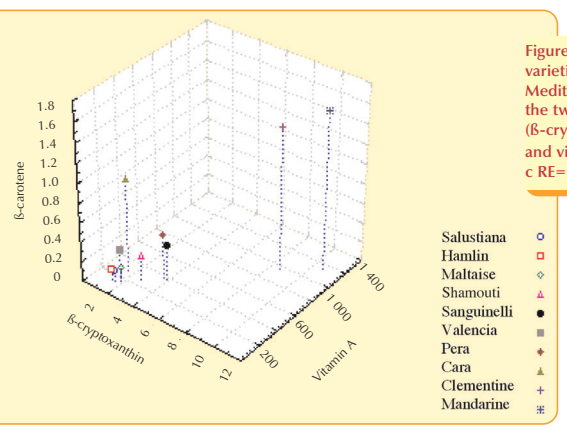



Figure 1. Differentiation of Citrus varieties and species from Mediterranean origin according to the two main carotenoids (ß-cryptoxanthin and ß-carotene) and vitamin A[c] values (a,b mg · $L^{-1}$; c RE= retinol equivalent ).

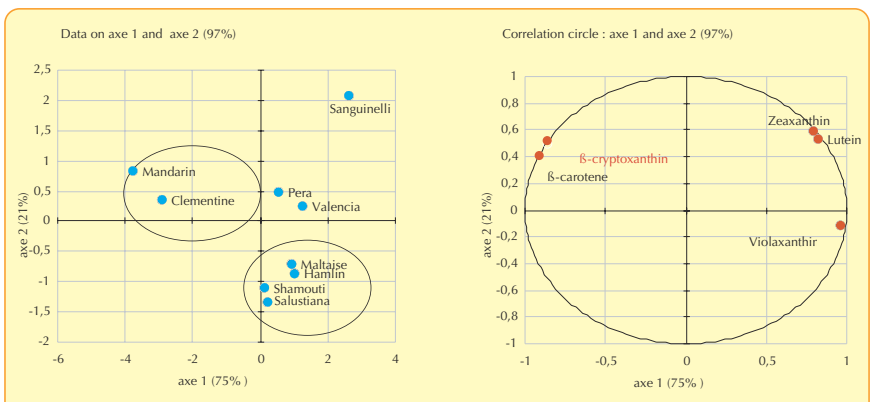



Figure 2. Differentiation on carotenoid profile using Principal Component Analysis (PCA) of 10 Citrus cultivars. Among Citrus cultivars tree distinct groups were observed. PCA gave informations on the differentiation of Mediterranean orange varieties and mandarin species based on nutritional criteria.

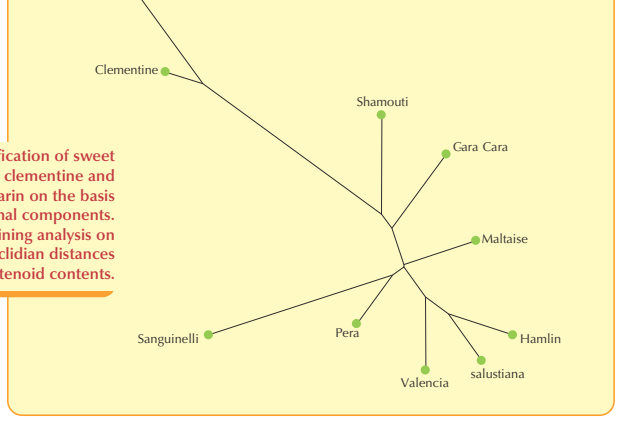



Figure 3. Classification of sweet oranges, clementine and "comune" mandarin on the basis of nutritional components. Neighbour joining analysis on Euclidian distances from carotenoid contents.

## Conclusion

This study allowed to make a varietal selection on nutritional criteria for *Citrus* growing in Mediterranean area. Pera and Sanguinelli cvs. appeared particularly interesting among sweet oranges while clementine and mandarin displayed the highest values of provitamin A. Mediterranean mandarin seemed to be promising as parent for nutritional breeding.


**References**

Goodner K.L., Rouseff R.L., Hofsommer H.J. (2001) Orange, mandarin, and hybrid classification using multivariate statistics based on carotenoid profiles. *J. Agric. Food Chem.* 49, 1146-1150.

Taungbodhitham A.K., Jones G.P., Walhlqvist M.L., Briggs D.R. (1998) Evaluation of method for the analysis of carotenoids in fruits and vegetables. *Food Chem.* 63, 577-584.



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